CALIFORNIA DIVISION OF MINES AND GEOLOGY
FAULT EVALUATION REPORT FER-211

Faults in the Susanville-Eagle Lake area Lassen County, California

by

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April 20, 1990

INTRODUCTION

Northwest-trending faults extend from southeast of Susanville through the Eagle Lake area (Figure 1). These faults may be a continuation of the Honey Lake fault zone and of the Walker Lane (Pease, 1969). Normal offset of Cretaceous through Late Pleistocene rocks has been mapped by Grose (1982), Grose and Porro (in press), and Youngkin (1980). A damaging earthquake felt at Eagle Lake and Susanville in 1921 suggests that some of these faults may be active (Kemnitzer, 1921).

Faults in the Susanville-Eagle Lake area lie within the current Modoc Plateau study region and may be active. They are evaluated here for possible zoning under the Alquist-Priolo Special Studies Zones Act (Hart, 1988).

SUMMARY OF AVAILABLE DATA

Faults in the Susanville-Eagle Lake area were first mapped by Lydon and others (1960) who show north to northwest-trending faults offsetting Cretaceous granitic bedrock and Pliocene through Recent (late Pleistocene, Grose 1982) volcanic rocks. Pease (1969) considered a northwest trending fault that extends from near Susanville through Eagle Lake to be a "significant strike-slip" fault and part of the major, right-lateral Walker Lane fault system (Figure 1). Pease (1969) considered it and related faults to be a result of deep-seated right-lateral shear.

Mapping by Youngkin (1980) and Grose (1982) has refined the locations of the faults and the ages of the offset units. Most faults are shown to be covered by Quaternary volcanic or alluvial units (Figure 2).

The youngest offset units in the Eagle Lake area mapped by Youngkin (1980) are a late Pleistocene basalt (170 ka; dated by K-Ar) that originated at Black Mountain and an overlying basalt (the Eagle Lake olivine basalt) that originated near the east shore of Eagle Lake, north of Black Mountain. This last basalt flow, which Youngkin considered to be late Pleistocene, flowed down upper Willow Creek Valley (in sections 22, 23, and 26, T32N R11E) and flowed over the scarp at locality 7 (Figure 2). The Eagle Lake olivine basalt is not offset by this fault (Youngkin, 1980). It is offset along a northeast trending fault near the shore of Eagle Lake (locality 5, Figure 2).

Youngkin (1980) considered this youngest basalt flow on the east side of Eagle Lake to be a possible equivalent of the Brockman Flat lava beds on the west side of Eagle Lake. Grose (1982) mapped several faults offsetting the basalt flows at Brockman Flats.

The pattern of faults shown by Grose (1982) shows two general groups of faults. These are: 1) north- and northwest-trending normal faults west of Eagle Lake; these faults generally have down to the east offset; 2) northwest-trending faults between Susanville and Eagle Lake; these faults also form the prominent fault-bounded peninsulas into the northern end of Eagle Lake.

INTERPRETATION OF AERIAL PHOTOGRAPHS AND FIELD CHECKING

Geomorphic evidence for recent faulting was interpreted on aerial photographs and plotted on 15-minute topographic maps (Figure 1). Aerial photographs of approximately 1:20,000 scale, taken by the USDA in 1954 were used for the entire area.

Geomorphic expression of faulting and units offset by faults were field checked on September 25-27, 1989. Geomorphic evidence for recent faulting was noted and the degree of weathering of basalt flows was examined at several locations where evidence for Holocene or late Pleistocene fault offset was expected to be particularly clear, based on the aerial photo interpretation. Localities field checked are plotted on Figure 2 and described below.

Faults west of Eagle Lake

North- and northwest-trending normal fault scarps west of Eagle Lake are degraded and generally talus covered. No offset of talus or alluvium was observed. One fault west of Penitentiary Flat (locality 1, Figure 2) is covered by a cinder cone and lava flow. The erosionally degraded appearance of the cinder cone indicates that it is pre-Holocene. The fault has not ruptured since the cinder cone formed and therefore is not active.

Faults mapped by Grose (1982) in the late Pleistocene basalt of Brockman Flat at locality 2 (Figure 2) and similar features at locality 3 (Figure 2) were examined in the field on September 26, 1989. A zone of northwest-trending fissures was observed at locality 2. The main fissure is one to two meters wide for most of its length, reaches a maximum width of about four meters, and is up to ten meters deep. This fissure is very linear and is paralleled by other smaller fissures. No vertical offset of the ground surface was observed along it.

Similar fissures were also observed at locality 3. These fissures are similar in trend to those at locality 2 and are up to ten meters wide and up to about seven meters deep. Vertical offset was observed at several locations but there was no consistent sense of offset. Maximum observed down-to-the-west offset was 0.5 m. Maximum down-to-the-east offset was 1.5 m. Lack of consistent offset suggests that these fissures may have formed by the lava flowing over a pre-existing fault scarp or other obstruction, not post-lava faulting.

At both localities 2 and 3 the sides of the fissures and the rubble within the fissures appeared to be equally weathered throughout the fissure and approximately equal to the amount of weathering of the flow surface. This suggests that the fissures formed at one time, shortly after the basalt was deposited in the late Pleistocene.

Faults between Susanville and Eagle Lake

The fault along Dean's Ridge, considered to be a "significant strike-slip fault" by Pease (1969), does have some evidence for right-lateral offset. Romstock Canyon and two canyons to the north are right-laterally deflected at the fault and more sharply incised northeast of the fault. This fault related geomorphology is relatively degraded and occurs in resistant granitic bedrock. Evidence for latest Pleistocene to Holocene displacement on this fault was not observed. This fault, and other northwest trending faults between Susanville and Eagle Lake are generally erosionally degraded and talus covered.

Scarps and troughs in talus along the eastern margin of Papoose Meadow (locality 4, Figure 2) appear to be geomorphically young, but are short, discontinuous features confined to individual talus cones. They appear to be related to the original depositional form of the rock fall deposits or continued instability of the steep talus slope. Other similar scarps on the same trend to the north appear to be the toe of a landslide.

Very fresh, sharp scarps were observed along the west margin of Round Valley. These closely follow topographic contours around the edge of the valley. They are probably shorelines caused by a recent high stand of Round Valley Lake.

Faults across the northern end of Eagle Lake

Northwest- and some northeast-trending normal fault scarps are found on both sides of Eagle Lake and fault bounded blocks form long peninsulas into the northern end of Eagle Lake. These scarps are generally talus covered except where they have been enhanced by wave action along the shores of Eagle Lake.

The scarp at locality 5 (Figure 2) has been modified by wave action during a pre-historic (probably Holocene) high stand of Eagle Lake. The lower ten meters of the scarp consists of rounded basalt boulders but the upper 3 meters consists of angular blocks of basalt bounded by vertical scarps and fissures. This upper scarp may have formed by fault movement or by scarp retreat associated with the undercutting of the scarp by waves.

A fault to the east at locality 6 (Figure 2) forms a two to five meter high scarp in the late Pleistocene basalt of Black Mountain (170 ka, Youngkin, 1980). This scarp extends across the mouth of a broad, shallow tributary valley and offsets it vertically, down-to-the-south. The basalt floor of the valley is displaced by two scarps about five meters apart. No alluvium was exposed in the drainage or the scarps. The upper scarp is about 1.5 m. high and the lower scarp about 0.5 m. high. The intermittent stream has not significantly incised either scarp.

Farther to the southeast the fault at locality 7 (Figure 2) is marked by a long, narrow ridge in the overlying late Pleistocene basalt flow (Youngkin, 1980). This ridge stands 1 to 3 meters over the surrounding lava flow. The surface of the flow is warped over the ridge, probably because the viscous lava flowed over the preexisting fault scarp. Fault offset of this Pleistocene basalt flow was not observed, although the crest of the ridge is marked by deep fissures and scarps with varying sense of displacement.

SEISMICITY

With the exception of the series of earthquakes described by Kemnitzer (1921) that culminated in a damaging earthquake felt at Eagle Lake and at Susanville, the Susanville-Eagle Lake area has been seismically quiet. The U.C. Berkeley catalog (Bolt and Miller, 1975) shows no other earthquakes for the period 1919-1972. The U.S.G.S. Catalog (U.S.G.S., 1985) shows no events in the area for the period 1969-1984.

CONCLUSIONS

Northwest-trending faults in the Susanville-Eagle Lake area offset Cretaceous through late Pleistocene rocks. These faults are generally defined by broad, eroded scarps and linear ridges and valleys. They may have had Quaternary right-lateral offset, as proposed by Pease (1969), but do not have evidence for Holocene displacement.

Faults in late Pleistocene basalt near Eagle Lake are marked by relatively sharp fissures and scarps (localities 2 and 3, Figure 2). The weathering of the basalt on the flow surfaces and in the fissures suggests that the fissures and scarps formed shortly after the basalt was deposited in late Pleistocene time.

Sharp scarps and side-hill troughs east of Papoose Meadows (locality 4, Figure 2) are short discontinuous features on a very steep talus slope. They appear to be related to debris flows and landslides, not faulting.

A relatively young scarp on the east side of Eagle Lake may have formed by fault movement in latest Pleistocene to Holocene time but has probably been enhanced by scarp retreat caused by wave erosion (locality 5, Figure 2). The other apparently youthful scarp east of Eagle Lake is well defined the late Pleistocene basalt of Black Mountain (170 ka) across a minor drainage (locality 6, Figure 2) but is covered by the late Pleistocene Eagle Lake olivine basalt about 1 km to the southeast at locality 7 (Figure 2). The late Pleistocene Eagle Lake olivine basalt does not appear to be offset at locality 7.

RECOMMENDATIONS

The faults evaluated in this report do not show clear evidence for Holocene offset. They should not be zoned under the Alquist-Priolo Special Studies Zones Act.

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Report review & approved
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5-16-90

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